

Spectroscopic Programs for Photo-z Validation and Calibration

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Leiden Lorentz Meeting

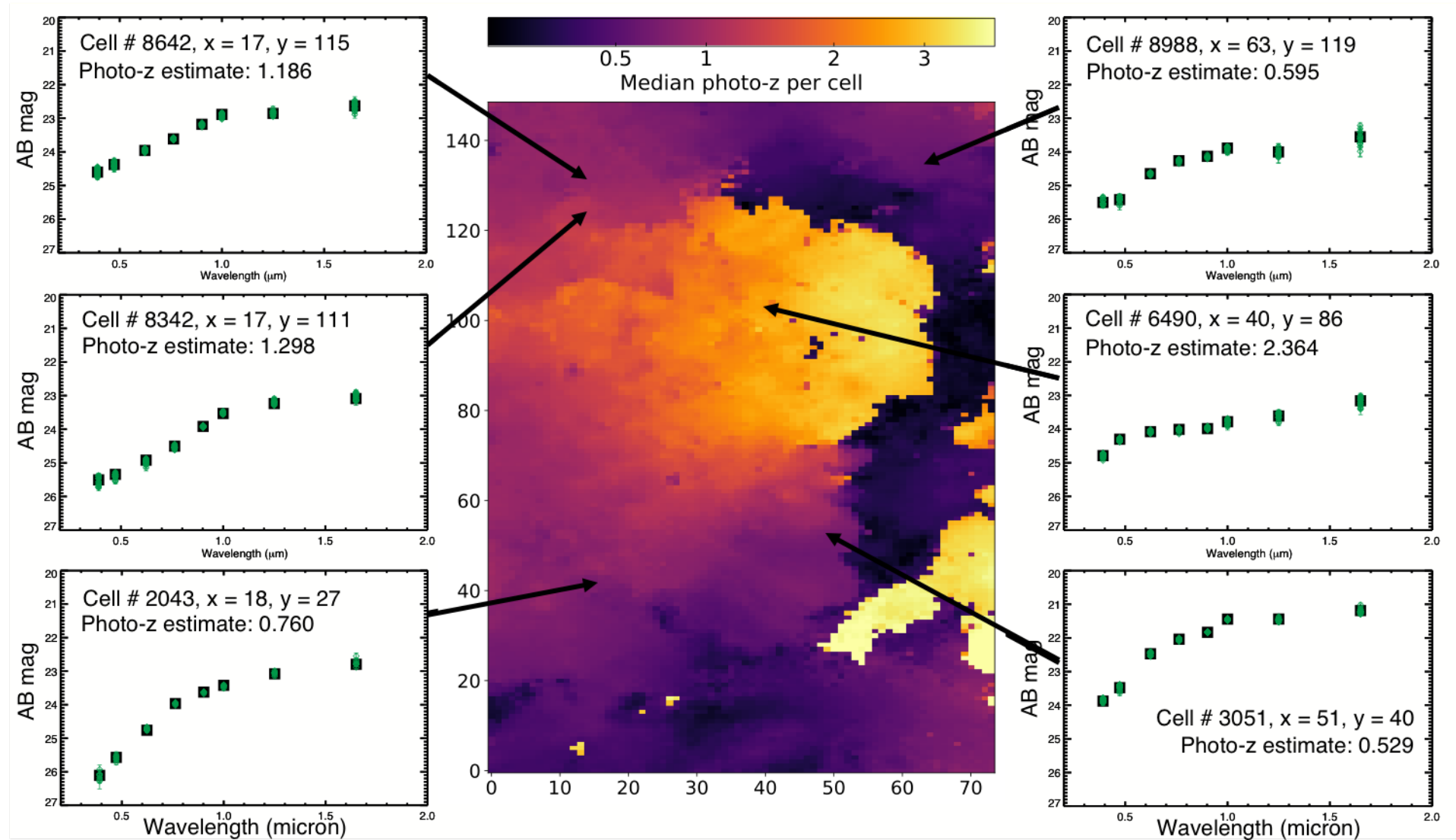
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The Redshift Measurement Problem

- Billions of galaxies will be imaged by the Stage IV cosmology surveys
- Only possible to get spectroscopic redshifts for a small fraction
- Weak lensing cosmology requires that the redshift distributions of galaxies in ~ 10 -20 redshifts bins be known with **high accuracy**

→ **Photometric redshifts will necessarily be crucial for weak lensing cosmology with these missions**

Self-organized map of galaxy colors to Euclid depth



C3R2 = Complete Calibration of the Color-Redshift Relation

Judith Cohen (Caltech) - PI of Caltech Keck C3R2 allocation

16 nights (DEIMOS + LRIS + MOSFIRE, [kicked off program in 2016A](#))

Daniel Stern (JPL) - PI of NASA Keck C3R2 allocation

10 nights (all DEIMOS; “Key Strategic Mission Support”)

Daniel Masters (JPL) – PI of NASA Keck C3R2 allocation 2018A/B

10 nights (5 each LRIS/MOSFIRE; “Key Strategic Mission Support”)

Dave Sanders (IfA) - PI of Univ. of Hawaii Keck C3R2 allocation

6 nights (all DEIMOS) + H20

Bahram Mobasher (UC-Riverside) - PI of UC Keck C3R2 allocation

2.5 nights (all DEIMOS)

+ time allocations on VLT (PI F. Castander), MMT (PI D. Eisenstein), and GTC (PI C. Guitierrez)

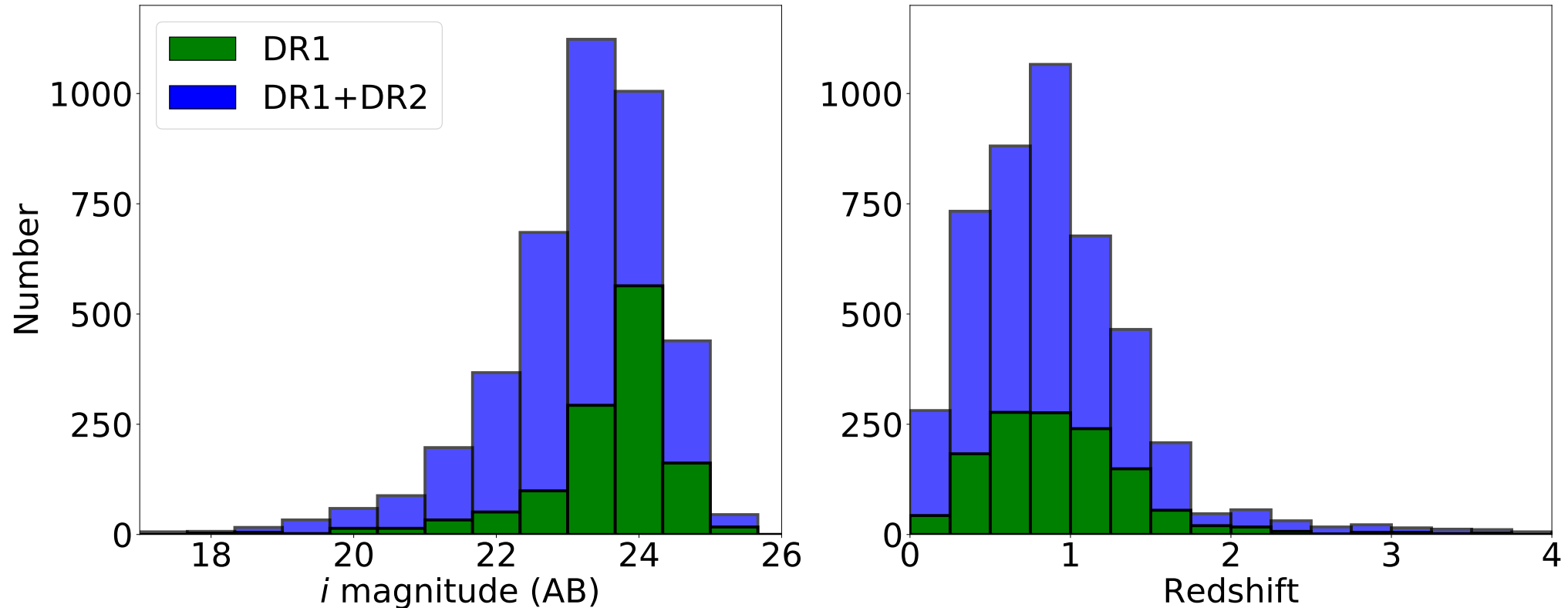
- Coordinating closely with these collaborators for these observations

- Sample drawn from 6 fields totaling $\sim 6 \text{ deg}^2$

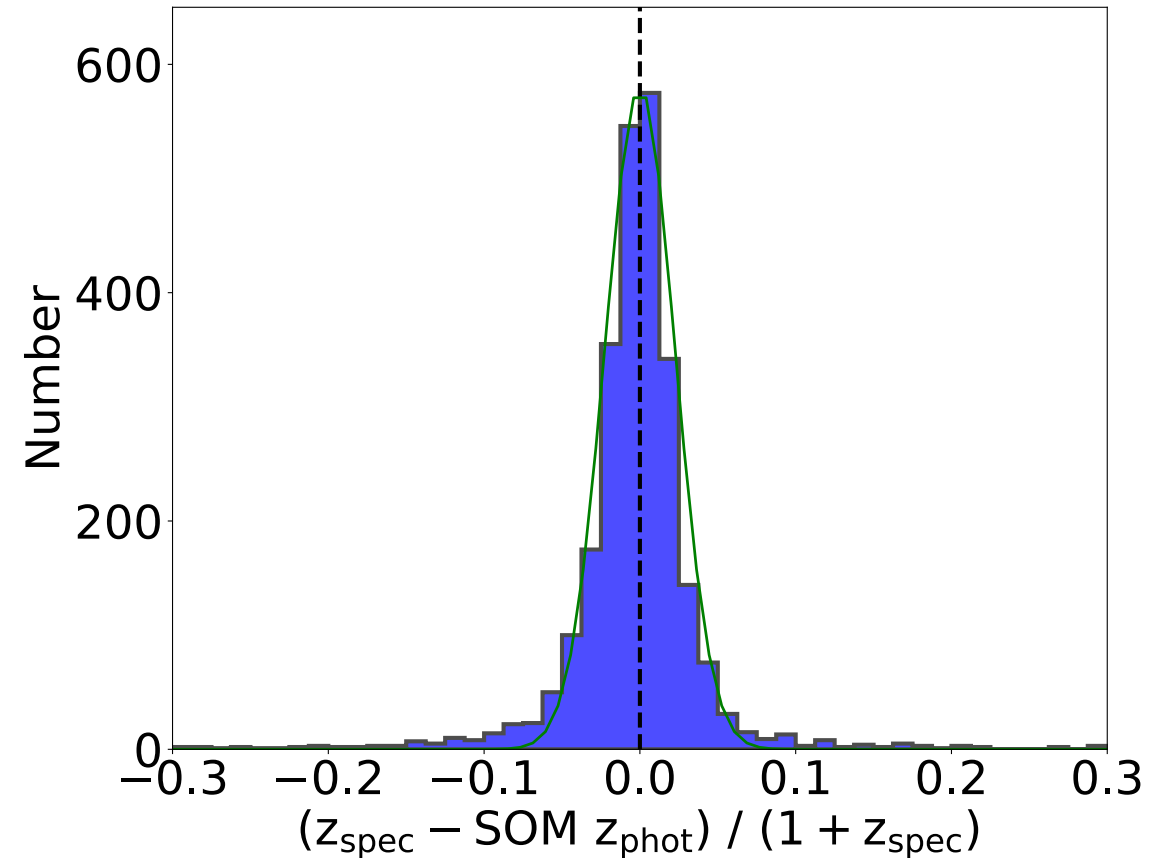
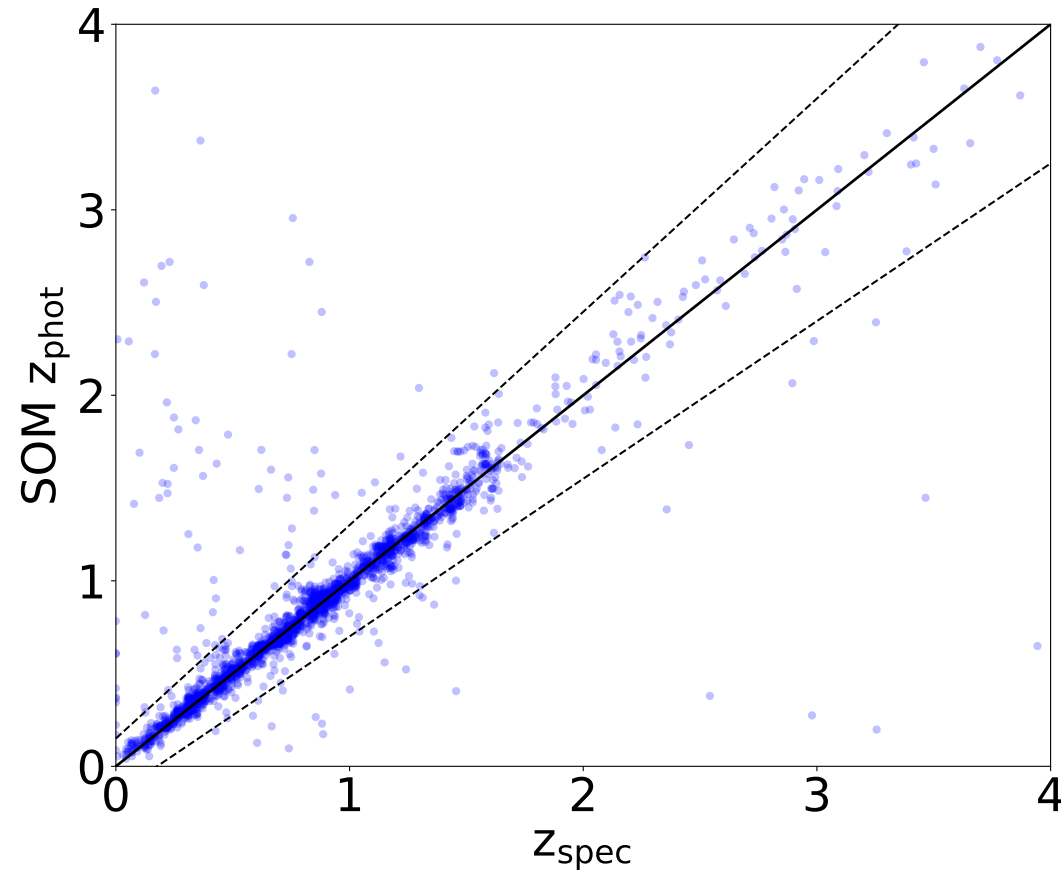
Additional Collaborators: Peter Capak, S. Adam Stanford, Nina Hernitschek, Francisco Castander, Sotiria Fotopoulou, Audrey Galametz, Iary Davidzon, Stephane Paltani, Jason Rhodes, Alessandro Rettura, Istvan Szapudi, and the Euclid Organization Unit – Photometric Redshifts (OU-PHZ) team

C3R2 stats through DR2 (2016A-2017A)

- 29 nights, ~19 good weather
 - 22 DEIMOS, 5 LRIS, 2 MOSFIRE
- 6696 spectra: 4534 $Q \geq 3$ (high quality), 3971 $Q = 4$ (certain)

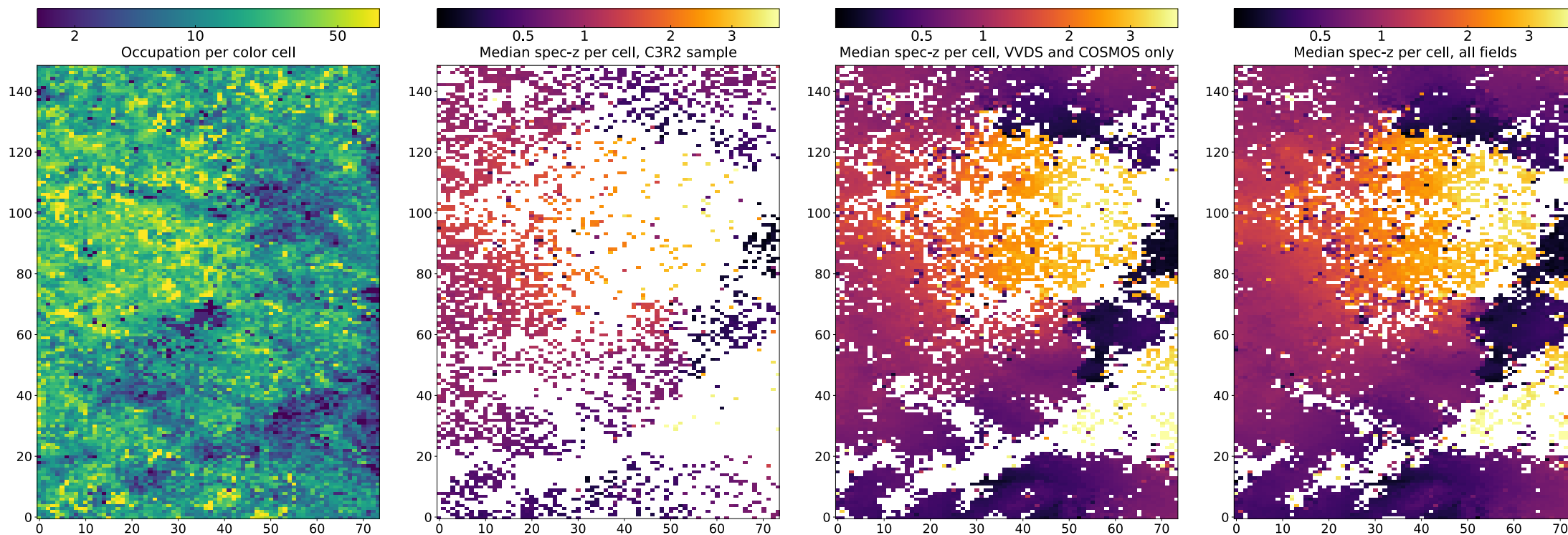


C3R2 – SOM-based photo-z



Outlier fraction 4.7%, scatter < 3%, bias of 0.18%
Method achieving unbiased performance!

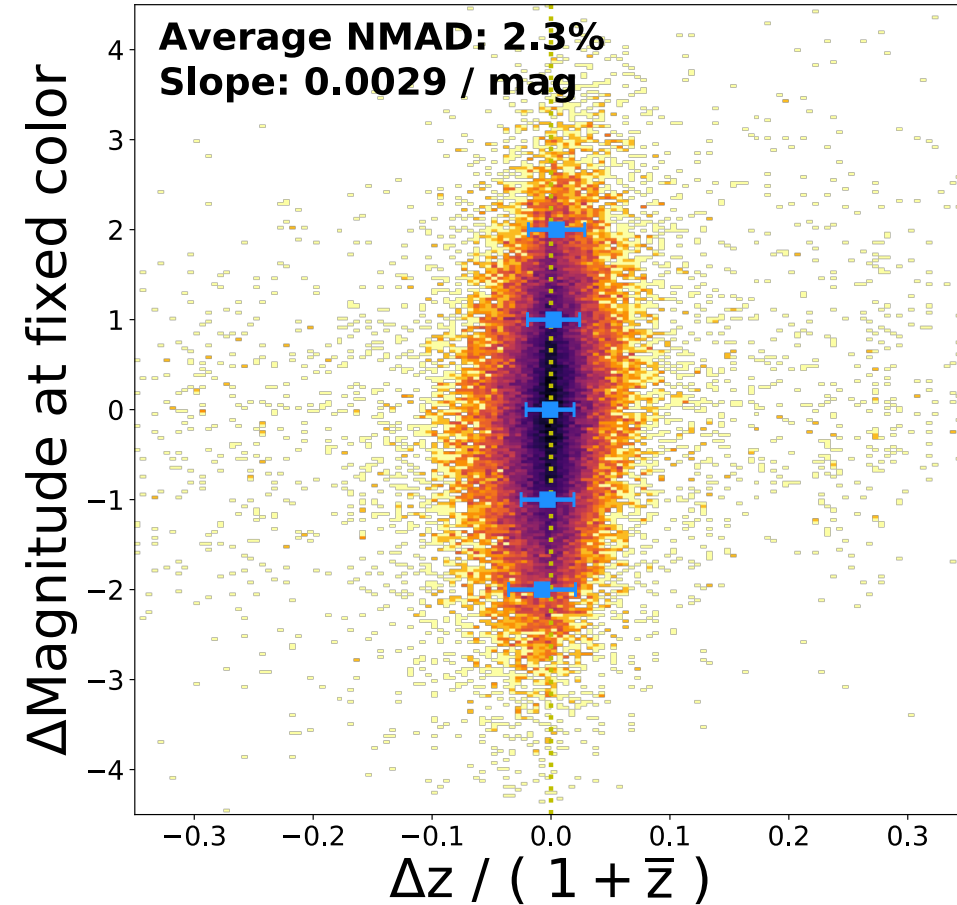
Color coverage to Euclid depth



- Much of the galaxy color space explored to significant depth (>85% of galaxies in cell with at least 1 specz)
- Small fields ($\sim 1\text{-}2 \text{ deg}^2$) means cosmic variance an issue
 - Is $P(z|C)$ relation we derive fully applicable to wider fields?
 - Are we missing relevant parts of the galaxy color space?

Magnitude (in)dependence

- Compare spec-zs of unique pairs of galaxies at fixed color (SOM position)
- Illustrates weak secondary dependence of redshift on magnitude at fixed color in the LSST+Euclid color space



Summary

- C3R2 survey is a major initiative with the Keck telescopes to enable cosmology in the 2020s
- Survey has obtained >4500 secure redshifts of faint galaxies to calibrate $P(z|C)$ relation
- Initial tests of the method are very promising.
- DR1 published; DR2 soon to be submitted